DOCUMENT RESUME

ED 239 878 SE 043 834

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TITLE What is Matter? Study Guide. Unit C1. ZIM-SCI, Zimbabwe Secondary School Science Project.
INSTITUTION Ministry of Education and Culture (Zimbabwe).; Zimbabwe Univ., Harare. Science Education Centre.
PUB DATE Feb 81
NOTE 31p.; See SE 043 835 for teacher's guide; for related documents, see SE 043 827-859.
AVAILABLE FROM University of Zimbabwe, P.O. Box MP 167, Mount Pleasant, Harare, Zimbabwe.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Chemical Reactions; *Chemistry; General Science; *Matter; *Science Activities; Science Education; *Science Experiments; Science Programs; Secondary Education; *Secondary School Science; Units of Study
IDENTIFIERS *Zimbabwe Secondary School Science Project

ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This ZIM-SCI study guide is a two-part unit consisting of activities and experiments which focus on chemical concepts and basic laboratory skills. The ideas that matter is composed of small particles and that chemical energy is involved when these particles react are stressed throughout the unit. Activities and experiments in part 1 examine the breakdown of substances into smaller pieces (leading to the idea of a "smallest possible" particle) while those in part 2 lead to definitions of a chemical reaction, element, and compound. A self-test and summary section are included. Information to help students understand the scientific principles behind the activities and experiments is also included. (JN)

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ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

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STUDY GUIDE UNIT C1

What is matter?

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

SE 043 834

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Acknowledgement: We are grateful for the ready cooperation and assistance we have received from the Audio Visual department of the Ministry of Education and Culture in the preparation of art work.

FEBRUARY, 1981

Printed by the Government Printer

Zim - Sci

Zimbabwe Secondary School Science Project

GENERAL SCIENCE

STUDENTS : Please read this carefully. It will help you.

How you will study

This study guide comes to you with a kit of apparatus. Both things are part of a study programme leading you to an understanding of aspects of science. In this course you will be carrying out experiments. The study guide will help you to understand the scientific principles behind the experiments.

Your work should be done as you are instructed, either by the teacher or the study guide.

To help you to see quickly what you must do, the study guide uses these symbols.

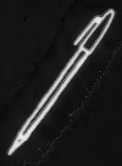
for "Read special notes".

for "Take note of an important point that you should learn."

for "Summary". This is to help you to go over what you have learned.

for "Experiment".
When you see this sign, read the instructions carefully from beginning to end before you start to do the experiment.

for "How much do you know?"
This is for you, to help you to test whether you are remembering what is important.



for "Written work". This is when you must answer questions in writing.

for Listen to the teacher and do exactly what the teacher tells you to do

GENERAL SCIENCE

UNIT C 1 : WHAT IS MATTER

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UNIT C 1

AIM OF THIS UNIT

When you have completed this unit, you will be able to:

1. Show that matter is made up of small particles.
2. Explain what happens when a chemical reaction takes place.
3. Describe the differences between a mixture and a compound.
4. Separate a mixture of salt and sand.

You should be able to define:

1. An element,
2. A compound,
3. An atom,
4. A physical change,
5. A chemical change.

GENERAL SCIENCE UNIT C 1

Now that you have learned something about the world around you, we are going to take a closer look at what things are made of. Have you ever thought that your body is made up of chemicals? I expect that is a surprising idea to you, because your hands or your faces do not look anything like the chemicals you have in your classroom. But in fact the whole world is made of chemical substances, arranged in many different ways. This lesson will introduce you to some of these chemicals and help you to understand something about the way they behave.

Open your basic kit. For your first chemical experiment you will need these items:

1. Your GRADUATED BEAKER
2. Your EVAPORATING DISH
3. Your STIRRING ROD/SPATULA

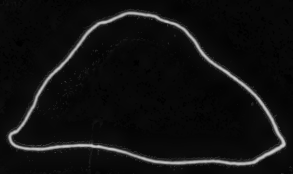
Have you found all those? Put them in front of you on an old piece of newspaper. Put the rest of the basic kit in a safe place where it will not bother you and make working difficult for you. DO NOT try to work in a messy place.

Your teacher will give you the following chemicals:

1. A small piece of copper wire.
2. Some dyestuff
3. Some seeds.

Now you are almost ready! Before you begin, you must find:

1. A container of water.
2. An old tin or pot in which to throw away unwanted liquids.
3. You should also go outside and find a rough stone about this size:



Wash the stone and dry it.

Before you begin the lesson, check that all the apparatus you have been asked to find is in front of you on the newspaper. Now your teacher will tell you what to do with the copper wire.

* * * * * * * *

We have succeeded in making our piece of copper much smaller than it was before but I am sure you can see that your smallest piece is still not as small as you could make it if you had a good knife (or sharper fingernails!)

Put the pieces of copper wire on one side out of the way. So: we have not obtained the smallest possible piece of copper. We shall call the smallest possible piece of something by a new name - we shall call it the smallest possible PARTICLE. It will be very very small indeed. We are going to try to find out how small this could be.

Let us have a look now at the dyestuff. Put it into your evaporating tin. Look at it closely. You will see that it is a dark reddish-blue colour - almost black in fact - and that it consists of many small pieces. How many do you think there are? It's difficult, isn't it? They are so small that it is very hard to count them. Could we make them smaller? Think about that for a moment.

Perhaps your teacher could give you some ideas?

* * * * * * * * * * * *

To follow on from what your teacher has said we have made a SOLUTION of dyestuff in water. There is much more WATER than there is DYESTUFF, but the dye is so strongly coloured that the whole solution looks pink.

Now we shall try to understand what happened to all the little pieces of dyestuff when we put them into water. Turn to page 5 in your study guide and look at Diagram 1. This diagram is a picture of your small beaker, and we shall use the picture by pretending that it is a real beaker full of water. Now open your packet of seeds.

Your teacher will tell you what to do with the seeds. Listen very carefully.

* * * * * * * * * * * *

Our seeds and beaker picture is called a "model" - it is not the real thing, it is a way of pretending something is happening so that we can understand more easily. We shall often use models of things in science to help us to understand. We cannot see our dye particles, so it is hard to think about them in the water. The model is used to help us to THINK.

Can we get any more information about the size of these dye particles? Let us try another experiment, but we shall use our MODEL first, to help us to understand what we are doing. Listen to your teacher again as you work with the MODEL.

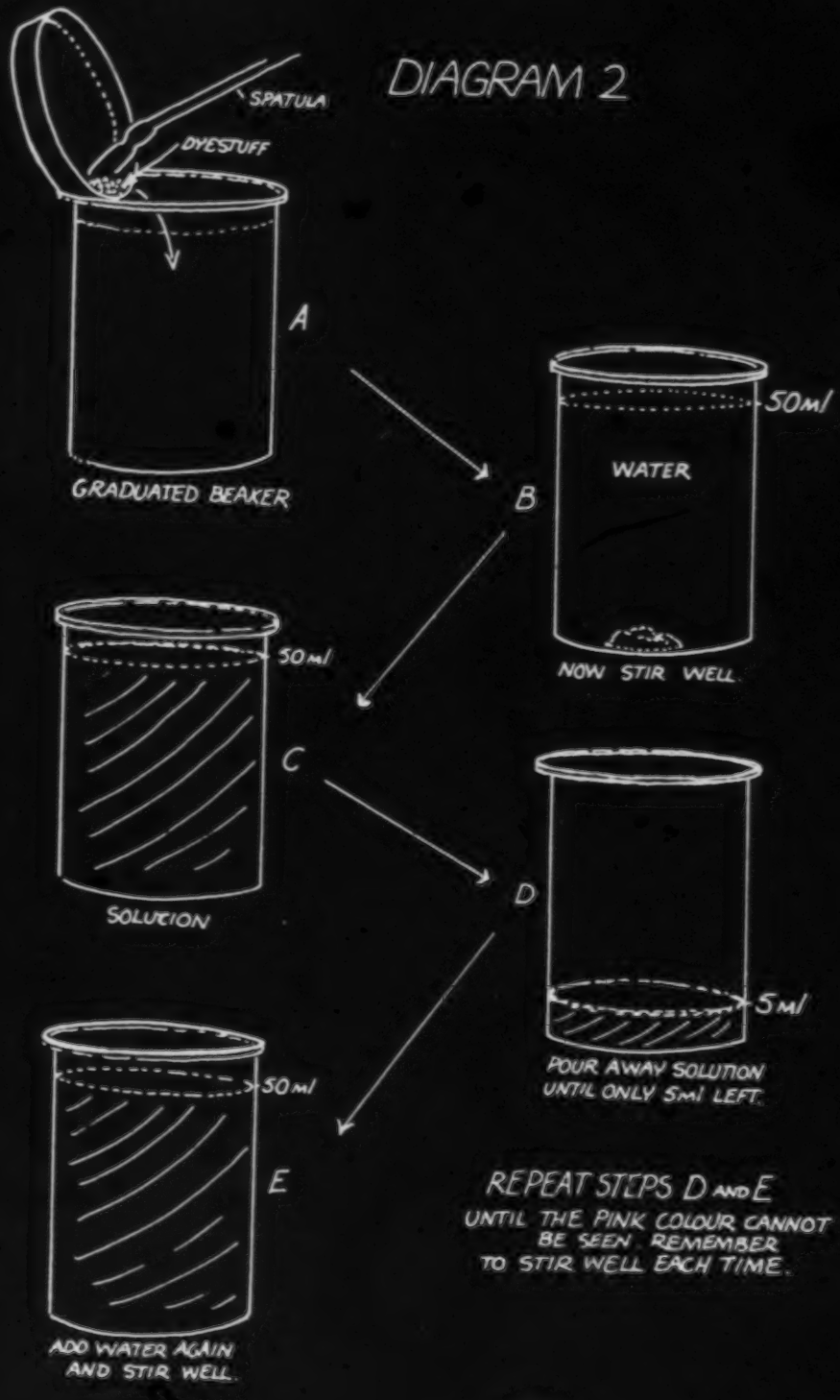
* * * * * * * * * * * *

Let us go over what we did once more. We started with MANY PARTICLES in our beaker, spread out over the picture just as we had spread the dyestuff through the water by stirring. Then we took most of the particles away. We spread out what was left and we took most of the particles away a second time. We were left at the end with very few particles, so that our picture had only two or three in the whole big space.

DIAGRAM 1

THIS IS A BIG PICTURE OF THE LITTLE BEAKER IN YOUR BASIC KIT

DIAGRAM 2



REPEAT STEPS D AND E
UNTIL THE PINK COLOUR CANNOT
BE SEEN. REMEMBER
TO STIR WELL EACH TIME.

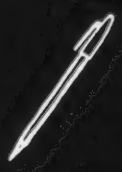
Now that we have practiced on our model, we shall do the experiment with our solution of dyestuff. Look at Diagram 2 on page of your study guide. Your teacher is going to give you additional instructions about how to do this experiment but the diagram will help you to understand.

DYESTUFF DILUTION EXPERIMENT

Look at Diagram 2 again. Firstly, you must put all the rest of the dyestuff into the beaker of solution that you made before, Stir VERY WELL. You now have a UNIFORM SOLUTION.

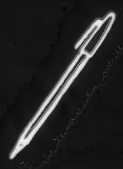
Now remove MOST of the solution by pouring it away carefully until you have only 5 ml left. Now add water again up to the 5 ml mark. Stir well. You have now DILUTED the solution ten times : it is ten times weaker than it was before and it contains one tenth as many particles.

You must go on making your solution ten times weaker by repeating steps D & E until you can no longer see the pink colour clearly. When the colour is hard to see, there will be very few particles left and the solution will be very like your seed model at the end.



Count how many times you have to DILUTE the solution before the colour is hard to see. Then complete the work given on the blackboard (Exercise 1).

Remember to put everything back in the box neatly when you have finished, making sure your beaker, dish and stirrer are washed clean.



Well done! You have completed your very first chemical experiment. In that experiment you decided that there must have been many, many particles in the little amount of dyestuff you used. It seems a wonderful thing that there were more particles in the dyestuff than there are people in the whole of Zimbabwe!

Your teacher will ask you to write a summary of all that you have learned so far. Write the summary in your exercise book. (Exercise 2).

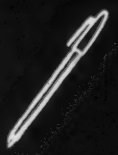
You will do another experiment about PARTICLES now. Try to remember your dyestuff experiment while you are carrying out this next one.

TO OBSERVE COPPER SULPHATE IN WATER

Take out the GRADUATED BEAKER again and your 5 ml MEASURE. Make sure that the beaker is clean. Find the COPPER SULPHATE from the supply of chemicals. It's a beautiful blue, isn't it? You will see that some of the pieces of copper sulphate are quite large. Put one of these large pieces into the beaker and add 20 ml water (using your 5 ml measure 4 times). DO NOT STIR.

You may have to leave this for some time before you notice anything happening, but you will see after a while that the water turns blue. You are making a SOLUTION OF COPPER SULPHATE IN WATER this time.

Look carefully at the piece of copper sulphate and then answer Exercise 3 in your exercise book..



Do not throw the solution away as you will need it later.

That was well observed! Now you have learned quite a lot about chemical substances.

So now we have the idea that the dyestuff and the copper sulphate both consist of very small particles, those of the dyestuff being dark red in colour and those of the copper sulphate being blue. We find that the idea of little particles is true for all chemicals. Just as you know that there are many different kinds of seeds such as beans, maize, sorghum and so on, so we find that there are many different particles. One kind make the tin you used, another the copper wire, and many kinds are put together to make you yourself.

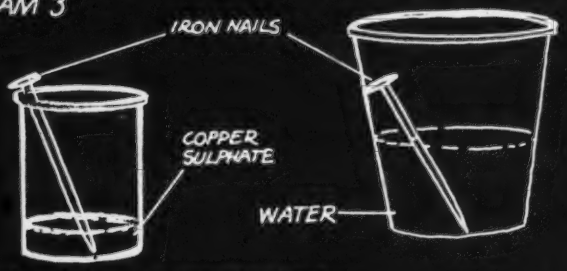
To find out more about this, you are going to have to make these different kinds of particles do some more things.

Let us think about the copper sulphate and the copper wire. The particles from which they are made must be different, and yet both names contain the word 'copper'. What do you think the difference between the particles might be? Think about it carefully before you read on.

Did you come up with any ideas? Perhaps I gave a clue when I mentioned their names? The word 'sulphate' must be important. Have you guessed the answer yet? The reason for the differences is that the wire is made of COPPER ONLY but the copper sulphate contains COPPER COMBINED WITH OTHER CHEMICALS. The other substances combined with copper are oxygen and sulphur. Your teacher will show you some sulphur. It doesn't look at all like copper sulphate, does it?

TO SHOW THAT COPPER IS ONE OF THE CHEMICALS IN COPPER SULPHATE

First, put all the rest of the blue particles of copper sulphate into the beaker of copper sulphate solution which you have already made. Stir well with your clean stirrer. Now find your TALL CUP, your 5 ml MEASURE and TWO IRON NAILS Put 20 ml water into the tall cup. Now put one nail into the solution of copper sulphate as shown below, and the other nail into the water in the tall cup. Leave them for a few minutes, then take out the nails. *DIAGRAM 3*



Now answer Exercise 4 in your exercise book.
You can throw away your solution and wash your beaker now.
Put the apparatus back in the box.

How did the copper break away from the other substances in the copper sulphate? When any chemical change occurs, the process is called a REACTION. You have met this word before, in your lesson on energy, and you know that energy is involved when chemical reactions take place.

Reactions occur between many different "chemicals". Sometimes the particles join up with others, and sometimes particles are pulled apart. You will now do some simple experiments to show some chemical reactions. First, a "pulling apart" kind of reaction.

TO OBSERVE A CHEMICAL REACTION

Find the AMMONIUM DICHROMATE.

This orange coloured chemical is the substance we shall use to start our experiment, so it is called the REACTANT. At the end of the reaction, we shall be left with the PRODUCT. Place all the ammonium dichromate in a little pile in the middle of your evaporating dish as shown in Diagram 4(a).

DIAGRAM 4.(a)

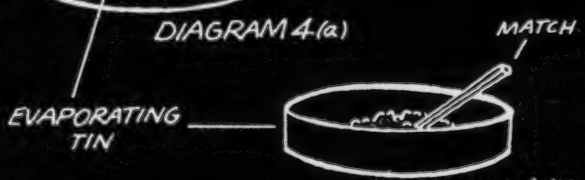


DIAGRAM 4(b)

Now light a match and hold it inside the middle of the pile as shown in Diagram 4(b), until the whole pile starts to fizzle and, in the end, catches alight. When it is burning well, pull out the match, blow out the match and watch the pile of orange chemical burning away. If it should stop reacting (this does not usually happen) just light another match to get it started again. (Feel how hot the dish has become by the end of the experiment!)

NOW answer Exercise 5 in your exercise book.

You need not keep this product.

That experiment is often called the 'Volcano Experiment!'

Heat changes are always an important part of chemical reactions. Sometimes heat is used up in the experiment, but more often heat is given out. You use this kind of heat-giving reaction every time you light a fire. You set off the reaction using a match, and then you sit next to the reactants and keep nice and warm!

Heat is given out or taken in because ENERGY CHANGES ARE TAKING PLACE. Chemical reactions are one more form of ENERGY CHANGE. Before we started the volcano experiment, the ammonium dichromate had CHEMICAL POTENTIAL ENERGY. Afterwards, you felt that the dish was hot and you realised that some of this energy was given out as HEAT.

In the case of your fire at home, and of the ammonium dichromate, you will notice that you did need a little bit of heat energy (the match) to get the reaction going. Once it was started, however, it made enough heat on its own to continue.

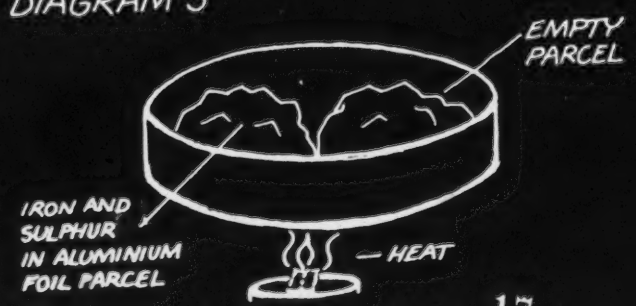
Now you will do another experiment with particles and energy change. In this one, the particles are going to join up, instead of being pulled apart.

TO HEAT IRON AND SULPHUR

You will need:
1. some SULPHUR
2. some IRON FILINGS
3. 2 pieces of ALUMINIUM FOIL
4. your clean EVAPORATING DISH
5. your PEG
6. set up your BURNER

Now you are ready to begin. Put 2 spatulas of iron filings and 2 spatulas of sulphur onto a piece of aluminium foil. Do not use all the iron and sulphur as you need some for later. Mix them up very thoroughly with your spatula. Then fold the foil into a parcel. Press the bottom flat. Now make another parcel of foil with NOTHING INSIDE IT. Try to make both parcels about the same size. Put both parcels into the clean evaporating dish and heat as shown below in Diagram 5, for half a minute. (Count slowly to 30 if you have no clock).

DIAGRAM 5



Remove the dish from the flame with your peg and pick up both parcels. (Careful! They are hot!) Hold one in each hand. As they cool, you will notice that the empty parcel cools much faster than the parcel of iron and sulphur. Let both cool completely. Now unwrap the aluminium foil and remove the substance inside. What do you find? Keep a piece of this hard stuff as you will need it again later. You may also find some iron filings left over. You do not need these. Throw them away. Perhaps you find a few pieces of sulphur? You do not need these either. All you should keep is the substance that you have made.

Now answer EXERCISE 6 in your exercise book.

Now you can write a "chemical sentence" to explain what you did. Chemical sentences are called "equations". You took some iron and some sulphur and reacted them together to get a new product, and the name of your product is 'IRON SULPHIDE'.

Here then is the chemical equation:

iron + sulphur + little heat energy = iron sulphide + much heat energy

We have seen that chemical reactions occur with products quite different from the reactants, and that heat energy is often an effect produced by chemical change.

Many chemical reactions show that there are some substances which cannot be made into simpler ones: that is they cannot be split up by a chemical reaction. Examples of such substances are iron, sulphur and copper. You did an experiment to get copper OUT of copper sulphate, but the copper itself cannot be broken up any further. You could use iron, sulphur and copper in many reactions to make products which contain these chemicals joined up with others, but you cannot break them into anything else.

Chemicals of this kind must be special. We call them "elements".

☆☆☆ DEFINITION: An element is a substance which cannot be split into two or more simpler substances by chemical means.

Copy this into your exercise book.

There are over 100 elements in all and each is different from the others. For example, copper does not behave like iron or sulphur.

You have looked at elements, and have performed experiments with them. For example, in the iron and sulphur experiment, you made a new substance by joining small PARTICLES of iron (an element) to PARTICLES of sulphur (an element) We ended up with PARTICLES of iron sulphide all stuck together in a lump.

When we are talking about the smallest possible particles of ELEMENTS, we call them "atoms". They are INDIVISIBLE: that is, they cannot be broken up any further.

☆☆☆ DEFINITION: An atom is the smallest indivisible particle of an element that can take part in a chemical change.

Copy this into your exercise book.

So you should really say "An atom of copper is different from an atom of iron or an atom of sulphur". Just as a maize seed is a different size and mass from a bean seed, so the atoms of different elements are of various sizes and masses.

Of course the mass of an atom is very small indeed - much too small to be able to think about it in your head - but you can understand that one atom might be heavier than another.

Every atom of copper is exactly like all other copper atoms. You will learn more about atoms later in the course and then you will be able to identify a picture of a copper atom immediately, just as you would be able to identify a picture of a maize seed. Elements combine with each other in many different reactions to make new products. When this happens, the new substance which has been made is quite different in appearance and behaviour from the elements which make it, as we saw with the copper sulphate. We call these products "compounds".

DEFINITION: A compound is a substance which consists of two or more elements chemically joined together.

Copy this definition into your exercise book.

You have used three compounds in experiments: copper sulphate, ammonium dichromate and dyestuff. You have also made one for yourself - iron sulphide. As you look around your house you will see many more - salt and water for cooking, milk, sugar and tea. Outside you will see soil and stones.

HOW MUCH DO YOU KNOW? WITHOUT referring to the text, write down the definitions of an element, a compound and an atom in your exercise book. Check back to see whether you were right.

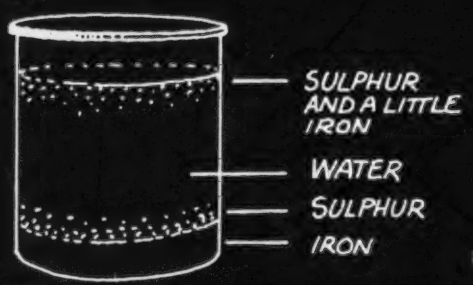
PART 2

When you performed your chemical experiments, you found that heat was required at the beginning to set the reaction going. Of course, once it had started it produced enough heat of reaction to keep on until the new compound had formed. You can now examine a mixture of iron and sulphur to see what happens if you do NOT apply the heat necessary for the reaction to take place.

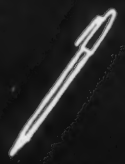
TO STUDY A MIXTURE AND A COMPOUND

Take all the rest of the IRON FILINGS and all the rest of the SULPHUR and place them in the evaporating dish. Mix them up very thoroughly. Find your ball of IRON SULPHIDE that you made earlier and put it in front of you next to the tin. Using your hand lens look at the appearance of the mixture and the compound first. In the mixture you will be able to see pieces of iron and sulphur separately even though you mixed them up very well. This is not the case with the compound, is it? I wonder whether you could separate the iron and sulphur again from the mixture? Let us see what happens if you put them into water. Take 2 spatulas of the mixture and place them in your beaker. Add 10 ml water, using your 5 ml measure twice. Stir it up and leave it for about a minute. You will find that the iron settles to the bottom and that some of the sulphur floats as shown in Diagram 6. A little iron may float too.

DIAGRAM 6



You have partially separated them by putting them into water, because the iron is heavier than the sulphur, but there is a much better way of doing it. Find the MAGNET in your basic kit. Rub one end in the mixture left in the tin, then lift it out. Blow gently to get rid of any stray pieces of sulphur. What has happened?



FILL IN THE ANSWERS TO EXERCISE 7, QUESTIONS 1 & 2.
Can you produce the same effect on the compound? Hold the magnet next to the compound and observe the effect. You will have to be careful and observe well when you do this. What about using water? Would that be a better way of splitting up the compound? Clean out your beaker very well and put in 10 ml of water. Drop the iron sulphide into the water. What happens?

COMPLETE EXERCISE 7 NOW.

You have discovered some differences between compounds and mixtures. Now you will examine a few more mixtures and try to find out more about them.

The mixtures you will study now are all mixtures of chemicals with WATER. Your solution of dyestuff was a mixture of this kind. You will therefore, be looking more closely at solutions.

TO MAKE A MIXTURE OF SAND AND WATER

Your teacher will give you some sand, which you must put in your beaker. (Make sure the beaker is clean!) Add 10 ml water to the sand. What happens? Stir well and wait for about one minute. You will see that, in the case of the sand and the water, you have NOT been able to make a solution. Keep the mixture of water and sand in a safe place for the moment.

If a substance mixes completely with the water, as the copper sulphate or the dyestuff did, we say that it is SOLUBLE in water. The sand is INSOLUBLE. The mixture of sand and water ended up as two layers and you could see the boundary between the layers quite clearly. There was no such boundary when you stirred up dyestuff with water. You can also say that the dyestuff DISSOLVES in water.

The chemical name for salt is sodium chloride. If you dissolve some sodium chloride in water, you will get a clear solution which tastes of salt. Let us try this now.

TO MAKE A MIXTURE OF SODIUM CHLORIDE AND WATER

Find your SODIUM CHLORIDE. Put 1 spatula of sodium chloride into your evaporating dish (which should be very, very clean) and add 10 ml water using your 5 ml MEASURE. Stir until all the sodium chloride has dissolved. The solution should be quite clear. Keep this solution for the next experiment.

This solution looks different from the salt which helped to make it. However you still have a MIXTURE because all the salt is still there unchanged. You have simply spread it out through the water as you did with your seeds in your model.

The mixture can be shown to contain salt by tasting it - do this now to prove to yourself that the salt is still there - but remember that you should NEVER TASTE ANYTHING UNLESS TOLD THAT IT IS SAFE TO DO SO. So the sodium chloride has not changed chemically into a new substance, but it has broken up into small particles.

Now look at diagram 7, opposite. This is the same picture of the beaker that you had in diagram 1. Put some seeds all over the model in diagram 7, as you did before.

Now pretend that the seeds are particles of sodium chloride, and that you would like to get them back again, out of the water. Pretend that you are taking the water away from the top of the model, so that those at the top are falling downwards towards the ones at the bottom. Push them all together. You will see from your model that all the seeds come together in a group. So it seems that, if you want to get the sodium chloride back out of the water, you will have to take the water away. How can you do that? THINK HARD before you read on.

Your teacher may ask the class to discuss this problem before you read anymore.

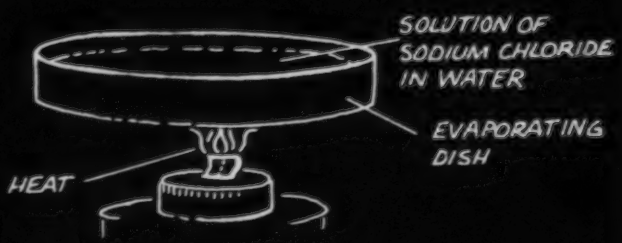
DIAGRAM 2. is the same picture of the beaker that you had in Diagram 1. Put some seeds all over the model in Diagram 2. as you did before.

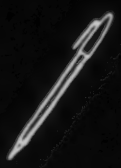
Did you wonder if you could heat the dish? When we heat water, we turn it into steam. This is called EVAPORATION. It does not require a very strong flame to do this - in fact it will happen without a flame if you leave it for a long time. The sodium chloride will not be affected, so you ought to be able to separate the mixture by heating.

TO HEAT A SOLUTION OF SODIUM CHLORIDE

Heat the sodium chloride solution over the flame of your burner as shown in Diagram 7 and fill in the answers to Exercise 8. Read all the questions carefully before you begin so that you know what to look out for.

DIAGRAM 8





Wash your dish well when you have finished.

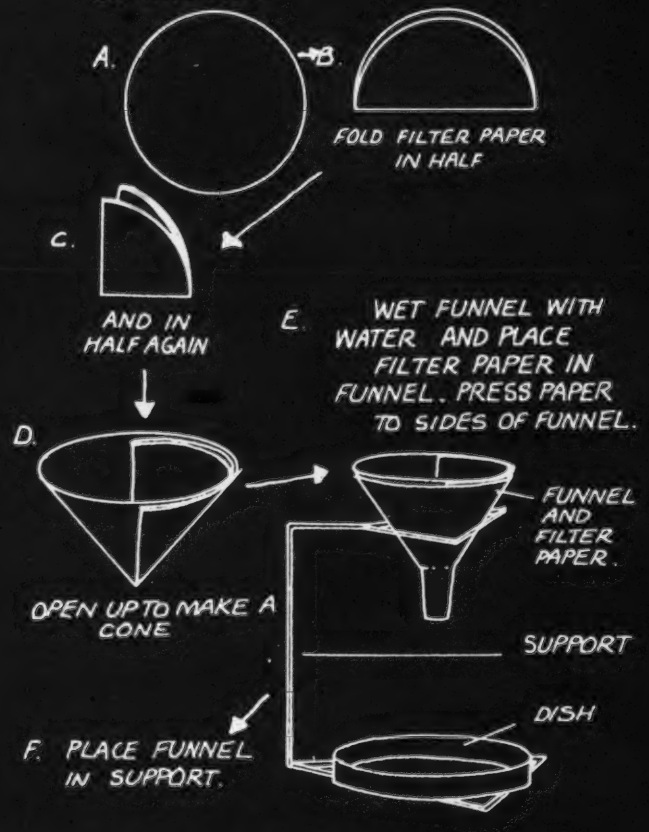
Now you know how to recover a dissolved substance from a solution. Let us return to the mixture of sand and water that you prepared earlier. You could recover the sand by evaporation if you wanted to, but there is another way of separating the two parts of the mixture in this case.

Because you can see the grains of sand, they must be quite large. You will use a technique called FILTRATION to recover them.

TO FILTER A MIXTURE OF SAND AND WATER

Find your FUNNEL in your basic kit. Prepare the funnel for filtration as follows:

DIAGRAM 9



Stir up the sand and the water. CAREFULLY pour the mixture through the filtration apparatus. Watch what happens and try to guess how a filter paper works. You may have to add a little more water to get out all the sand.

NOW ANSWER EXERCISE 9.

The processes that you have used to recover parts of a mixture are all very simple, and did not involve other chemicals. In other words you separated the mixture by physical methods such as evaporation, filtration, or in the case of the iron/sulphur mixture, magnetism.

If we had been very sharp eyed, perhaps we could have separated the iron and sulphur just by looking closely at the mixture and separating the pieces one by one - but it would have taken a very long time!

When substances form compounds, however, we cannot separate them like that because the elements are bound up together forming an entirely new kind of substance. This is one of the most important differences between a compound and a mixture.

☆☆☆ DEFINITION: A physical change is one in which no new substance is formed.
A chemical change is one in which at least one new substance is formed.

For example, so far, you have performed these chemical changes.
- got copper from copper sulphate.
- broken up ammonium dichromate.
- combined iron and sulphur.

You have also performed these physical changes.
- mixed iron and sulphur and separated them using a magnet.
- put iron and sulphur into water.
- mixed sand and water.
- mixed sodium chloride and water.
- heated sodium chloride and water.
- filtered sand and water.

We are now in a position to make a table to help us remember the most important differences between a compound and a mixture. Read the table well.

TABLE 1

MIXTURE	COMPOUND
1. The substances in a mixture can be separated by physical means.	The elements in a compound cannot be separated by physical means.
2. The properties (colour, appearance etc.) are those of the substances making up the mixture.	The properties are quite different from the properties of the elements in the compound
3. Energy (e.g. heat) is not usually given out or taken in when making a mixture.	Energy is often given out or taken in when a compound is made.
4. A mixture has variable composition, that is, the the substances may be in any amounts and you will still have a mixture.	A compound has fixed amounts of each element in it, if there are extra quantities of any element they will be left over at the end of the reaction.

When you have completely finished, put everything away neatly.

Now get out your SEEDS, your TALL CUP and your STIRRER.

Your teacher will give you some sodium chloride and a string with a weight tied on. Have some water ready, and find a STICK from the garden, about the same size as your stirrer.

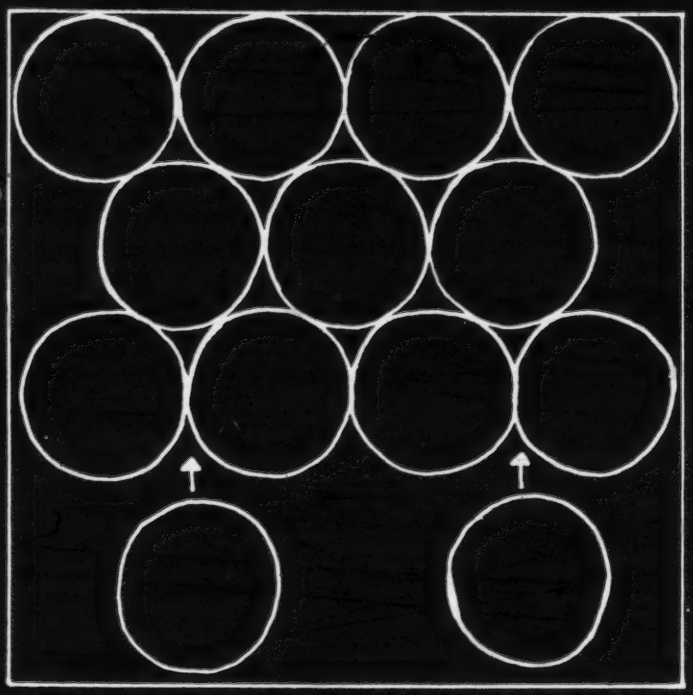
Now your teacher will tell you what to do next.

* * * * * * * * * * * *

To summarise then, particles pack closely together if they are allowed to combine slowly. The pattern they make when they come together depends upon their shape. Sodium chloride particles are not shaped like our seeds, they are round.

Have a look at Diagram 10 now.

DIAGRAM 10



This is a picture of round sodium chloride particles closely packed together. Can you see that they form straight lines? Of course our pieces of sodium chloride will not be flat, like our paper - they will join up on all sides to make a big lump. Our drawing is, once again, only a MODEL of what the chemicals actually do.

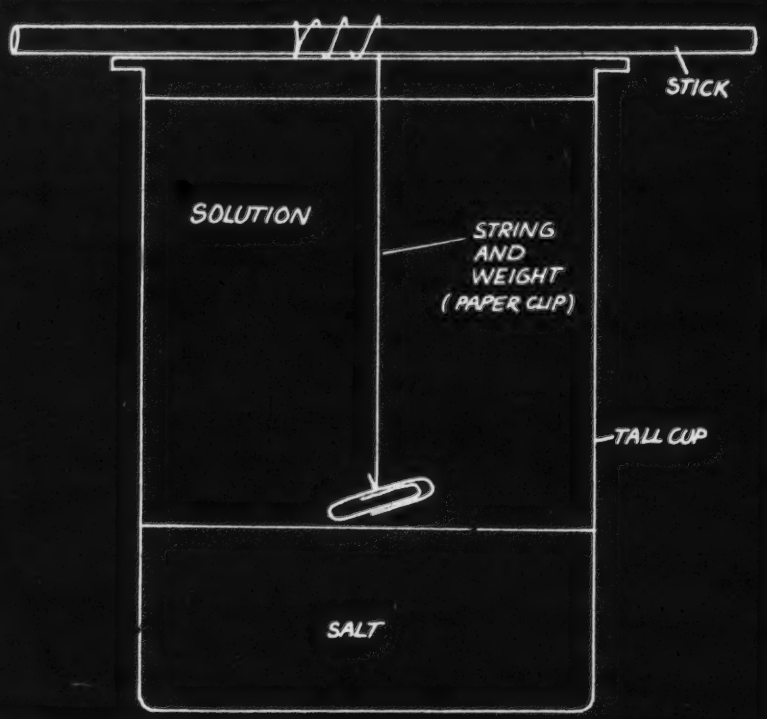
Your teacher will now tell you about the last experiment in this lesson.

To make sodium chloride particles join up slowly

Fill the tall cup half full of sodium chloride. Add water almost to the very top and stir VERY WELL. The solution of sodium chloride now holds as much salt as it possibly can.

Tie the string around the stick as shown in Diagram II and hang it so that the weight rests JUST on top of the salt. Leave the whole thing in a cool place for many days.

DIAGRAM 11



Summary Unit C1

Matter is made up of very small particles.

An element is a substance which cannot be split into two or more simple substances by chemical means.
A compound is a substance which consists of two or more elements chemically joined together.

An atom is the smallest indivisible particle of an element that can take part in a chemical change.

A chemical change is one in which at least one new substance is formed.

Chemical changes are called reactions.

A reaction occurs when reactants combine to give different products, generally with an energy change of some sort.

A physical change is one in which no new substance is formed.

Mixtures and compounds have very different properties (Table 1.)